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09/773,387	02/01/2001	Andrew Brookfield Swaine	350-205	3984

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EXAMINER

RUTTEN, JAMES D

ART UNIT	PAPER NUMBER
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2122

DATE MAILED: 01/29/2004

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/773,387

Applicant(s)

SWAINE ET AL.

Examiner

J. Derek Rutten

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 02 February 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-13 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-13 is/are rejected.
- 7) ☒ Claim(s) 6 and 13 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 02 May 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
- a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 4.

- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

1. Claims 1-13 have been examined.

Requirements for Information – 37 CFR § 1.105

2. Applicant and the assignee of this application are required under 37 CFR 1.105 to provide the following information that the examiner has determined is reasonably necessary to the examination of this application.

In response to this requirement, please provide the title, citation and copy of each publication that any of the applicants relied upon to develop the disclosed subject matter that describes the applicant's invention. In particular, please provide "Embedded Trace Macrocell Architecture Specification", Issue C, published December 3 1999, with a possible document ID "ARM IHI 0014C" (referred to on page ii of "Embedded Trace Macrocell: Architecture Specification" ID ARM IHI 0014I). Also, please provide the document referred to on page 16 of the originally filed specification on lines 19 and 20 as "Embedded Trace Macrocell (Rev1)". Also, please provide the document referred to on page 17 of the originally filed specification on lines 6 and 7 as "Embedded Trace Macrocell Specification", with a document ID "ARM IHI 0014D".

In responding to those requirements that require copies of documents, where the document is a bound text or a single article over 50 pages, the requirements may be met by providing copies of those pages that provide the particular subject matter indicated in the

requirement, or where such subject matter is not indicated, the subject matter found in applicant's disclosure.

The fee and certification requirements of 37 CFR 1.97 are waived for those documents submitted in reply to this requirement. This waiver extends only to those documents within the scope of this requirement under 37 CFR 1.105 that are included in the applicant's first complete communication responding to this requirement. Any supplemental replies subsequent to the first communication responding to this requirement and any information disclosures beyond the scope of this requirement under 37 CFR 1.105 are subject to the fee and certification requirements of 37 CFR 1.97.

The applicant is reminded that the reply to this requirement must be made with candor and good faith under 37 CFR 1.56. Where the applicant does not have or cannot readily obtain an item of required information, a statement that the item is unknown or cannot be readily obtained will be accepted as a complete reply to the requirement for that item.

This requirement is an attachment of the enclosed Office action. A complete reply to the enclosed Office action must include a complete reply to this requirement. The time period for reply to this requirement coincides with the time period for reply to the enclosed Office action.

Specification

3. The originally filed specification appears to include a reference reproduced in its entirety on pages 16-38. Published references should be submitted separately and listed on an information disclosure statement. Otherwise, it should be formatted and arranged in accordance with 37 CFR 1.52. Also see MPEP §§ 608.01.

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4. The spacing of the lines of the specification pages 16-38 is such as to make reading and entry of amendments difficult. New application papers with lines double spaced on good quality paper are required. See MPEP § 608.01 and 37 CFR 1.52(b).
5. As provided in 37 CFR 1.77(c), the specification of a utility application should include section headings that should appear in upper case without underlining or bold type.
6. The abstract of the disclosure is objected to because the reference to "Figure 3" near line 12 appears to be a typo. Correction is required. See MPEP § 608.01(b).

Claim Objections

7. Claim 6 is objected to because of the following informalities: There are two typos in line 2 of claim 6. The word "synchronising" should be --synchronizing--. Appropriate correction is required.
8. Claim 13 is objected to because of the following informalities: There is a typo in line 2 of claim 13. The word "analyse" should be --analyze--. Appropriate correction is required.

Claim Rejections - 35 USC § 112

9. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

10. Claim 11 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 11 recites the limitation "both behaviors" in line 2. There is insufficient antecedent basis for this limitation in the claim. For the purpose of further examination this

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limitation will be interpreted in light of page 12 line 31 through page 13 line 2 of the originally filed specification as “~~both~~ two behaviors simultaneously wherein the behaviors consist of: (i) said exact match signal is user configurable; and (ii) said exact match signal is set under hardware control depending upon a use of said trigger condition.”

Claim Rejections - 35 USC § 103

11. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

12. Claims 1, 2, 7-10, and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's admission of prior art on pages 2 and 3 of the originally filed specification (hereinafter referred to as “APA”), in view of European Patent Application Publication 0 465 765 A2, “Instruction Sampling Instrumentation” by Westcott and White (hereinafter referred to as “Westcott”).

a. As per claim 1, APA discloses:

(i) a processing circuit operable to process data values under control of processing instructions;

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(ii) a memory operable to store data values to be processed, said processing circuit being responsive to a data access instruction to access a data value stored within said memory; and

(iii) a tracing circuit operable to generate a stream of trace data identifying processing instructions executed and data values accessed by said processing circuit;

(See page 2, lines 13-15: “Tracing the **activity** of a data processing system whereby a **trace stream is generated** including **data** representing the step-by-step activity within the system is a highly useful tool in system development.”; also page 2, lines 19-21: “Examples of such on-chip tracing mechanisms are the **Embedded Trace Macrocell** provided by ARM Limited, Cambridge, England in association with their **ARM7 and ARM9 processors**.” ARM7 and ARM9 processors inherently process data values under control of processing instructions, otherwise they would not have any functional value. They also contain memory for data storage and inherently use access instructions for accessing the data from memory, otherwise they would not be able to process the data. The Embedded Trace Macrocell, or “ETM”, is the tracing circuit that identifies instructions and data used by the ARM chip. Note that further information regarding ARM9 processors can be found in “ARM966E-S: Technical Reference Manual” by ARM Limited.)

wherein

(iv) a data access instruction may result in a data miss such that a data value corresponding to said data access instruction is accessed upon a processing cycle subsequent to that upon which said access would occur without said data miss (page 3

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lines 5-12: “However, should a **load miss** occur whereby **the load of the data value cannot be satisfied** from the cache and requires a slower non-cache access, such as to a main memory, then the **data value will not be returned for possibly many processing cycles**. Rather than halt data processing, it is known to provide systems, such as the ARM1020T processor, in which other program instructions can continue to execute whilst the data from the previous load miss is still awaited providing those later instructions do not require or depend on the data value that has not yet been retrieved.”).

APA does not disclose:

(v) said tracing circuit is responsive to said data miss to generate a data place holder within said stream of trace data at a position where data identifying said data value would have been placed if said data miss had not occurred and then, when said access to said data value does occur, to insert at a later point in said stream of trace data a late data value identifying said data value.

However, in an analogous environment, Westcott teaches responding to a data miss and generating a tag which identifies an instruction for further processing and inserts a data value when it becomes available. (See column 5 lines 13-22: “In instruction sampling, instructions tagged with a preselected **instruction identity number (IID)** are identified by the instrumentation. When an instruction having the preselected IID is encountered, **information associated with that instruction is captured** as the out-of-sequence execution proceeds. **If the instruction completes, the captured information is stored** as a single instrumentation entry in a memory array.” This passage describes the general mechanism, where the IID functions as a data place holder.; Also column 2 lines

24-27: “As each instruction finishes execution it goes into a queue where it is **completed in sequence** even though it may have been executed out-of-sequence in the machine.”

Here, data is placed in a manner as if a data miss had not occurred.; Also column 13 lines 30-39: “On the first IID 24 instruction to complete during a **data cache fetch miss event**, after the value in the binary counter 503 reaches the N value in the threshold register 505, a sampling pulse will be generated on line 310. This mode causes only data associated with the processing of IID 24 instructions that cause data cache fetch misses to be saved in the Instruction Table Array” This describes the specific response to a data miss.)

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use Westcott’s instrumentation method with APA’s tracing circuit. One of ordinary skill would have been motivated to tie cache misses and other system events to the completed instruction that caused them.

b. As per claim 2, APA also/further discloses *the apparatus as claimed in claim 1, wherein said memory comprises a cache memory and a main memory, a data miss occurring when a data value being accessed is not stored within said cache memory* (APA page 3 lines 5-8).

c. As per claim 7, APA also/further discloses *the apparatus as claimed in claim 1, wherein said tracing circuit is operable to control tracing operation in response to a trigger condition associated with one or more of said data value and a memory address*

associated with said data value (page 2 lines 19-21. Trigger conditions are supported by the Embedded Trace Macrocell.).

d. As per claim 8, APA does not expressly disclose *the apparatus as claimed in claim 7, wherein said tracing circuit is responsive to an exact match signal such that a trigger condition associated with a data value for which a data miss occurs is either:*

(i) not triggered until said data value is accessed and found to meet said trigger condition; or

(ii) triggered upon said data miss upon an assumption that said data value when accessed will meet said trigger condition.

However, in an analogous environment, Westcott teaches using a sample pulse signal to indicate a match reactive to a trigger condition associated with a data value (See column 6 lines 7-15 and 26-31).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use Westcott's trigger with APA's tracing circuit. One of ordinary skill would have been motivated to collect only that data which is of particular interest and which meets a selected requirement.

e. As per claim 9, APA does not expressly disclose *the apparatus as claimed in claim 8, wherein said exact match signal is user configurable.*

However, in an analogous environment, Westcott teaches user selected trigger conditions (column 6 lines 7-11).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use Westcott's user selected trigger conditions with APA's trigger circuit. One of ordinary skill would have been motivated to collect only that data which is of particular interest.

f. As per claim 10, APA does not expressly disclose *the apparatus as claimed in claim 8, wherein said exact match signal is set under hardware control depending upon a use of said trigger condition.*

However, in an analogous environment, Westcott teaches event selection (match signal) based on a trigger condition (column 6 lines 45-47).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use Westcott's hardware event selection with APA trigger circuit. One of ordinary skill would have been motivated to provide an automatic signal for triggering.

g. As per claim 12, APA also/further discloses a method (page 2 lines 13-15: "step-by-step"). All other limitations have been addressed in the above rejection of claim 1.

14. Claims 3 and 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of APA and Westcott as applied to claim 1 above, and further in view of U.S. Patent 5,550,974 to Pennington et al. (hereinafter referred to as "Pennington").

- a. As per claim 3, the combination of APA and Westcott does not disclose *the apparatus as claimed in claim 1, wherein said data place holder includes a tag value and said late data value includes a matching tag value.*

However, in an analogous environment, Pennington teaches the use of tags as a way of relating data elements (Pennington column 2 lines 5-7: “The tag means stores a tag and asserts a matchline signal if the tag is logically equivalent to an input tag.”).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use Pennington’s tags with the combination of APA and Westcott. One of ordinary skill in the art would have been motivated to correlate two pieces of data.

- b. As per claim 4, the above rejection of claim 3 is incorporated.

APA does not disclose the *apparatus as claimed in claim 3, wherein when a plurality of data misses result in a plurality of data place holders being generated, late data values may be generated in a different order than their corresponding data misses.*

However, in an analogous environment, Westcott teaches collecting a plurality of instructions that result in cache misses which may be executed out of order (See column 4 lines 17-18; also column 10 lines 24-26; also column 2 lines 24-27).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use Westcott’s plurality of out-of-order traces with APA’s tracing circuit. One of ordinary skill would have been motivated to collect a plurality of traces in order to get a statistically relevant sample of instructions which are causing cache misses.

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15. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of APA and Westcott as applied to claim 1 above, and further in view of U.S. Patent 5,555,392 to Chaput et al. (hereinafter referred to as “Chaput”).

a. As per claim 5, the combination of APA and Westcott does not disclose *the apparatus as claimed in claim 1, wherein said data place holder includes data identifying how many outstanding late data values are awaited at that time.*

However, in an analogous environment, Chaput teaches the use of a field for counting the number of outstanding load misses (column 3 lines 35-36).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use Chaput’s load miss field with the combination of APA and Westcott’s tracing mechanism. One of ordinary skill would have been motivated to track the status of pending load operations.

16. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of APA and Westcott as applied to claim 1 above, and further in view of Chaput, and further in view of U.S. Patent 6,009,270 to Mann (hereinafter referred to as “Mann”).

a. As per claim 6, the rejection of claims 1 and 5 are incorporated. APA and Westcott do not disclose *the apparatus as claimed in claim 1, wherein said stream of trace data includes periodic synchronising data, said synchronising data including data identifying how many outstanding late data values are awaited at that time.*

However, in an analogous environment, Chaput teaches the use of a field for counting the number of outstanding load misses (column 3 lines 35-36). Further Mann teaches input of synchronization information into a data trace (column 2 lines 60-64).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use Mann's synchronization stream with Chaput's outstanding load miss count with APA and Westcott's tracing circuit. One of ordinary skill would have been motivated to provide synchronization information to a tracing circuit to allow proper trace collection.

17. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of APA and Westcott as applied to claim 8 above, and further in view of U.S. Patent 5,978,742 to Pickerd (hereinafter referred to as "Pickerd").

a. As per claim 11, APA does not expressly disclose: *the apparatus as claimed in claim 8, wherein said exact match signal has different values in different parts of said tracing circuit to provide two behaviors simultaneously wherein the behaviors consist of:*

(i) said exact match signal is user configurable; and

(ii) said exact match signal is set under hardware control depending upon a use of said trigger condition.

However, in an analogous environment, Westcott teaches user selected trigger conditions (column 6 lines 7-11), and event selection (*match signal*) based on a trigger condition (column 6 lines 45-47).

Further, in an analogous environment, Pickerd teaches a circuit providing two trigger behaviors simultaneously (column 9 lines 36-41).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use Pickerd's simultaneous trigger events and Westcott's behaviors with APA's tracing circuit. One of ordinary skill in the art would be motivated to collect information relating to multiple trigger events to enable further customization.

18. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of APA and Westcott as applied to claim 12 above, and further in view of U.S. Patent 6,139,198 to Danforth et al. (hereinafter referred to as "Danforth").

a. As per claim 13, APA discloses *controlling a data processing apparatus to analyse a stream of trace data* (as addressed in the above rejection of claim 12).

The combination of APA and Westcott does not disclose a computer program product carrying a computer program.

However, in an analogous environment, Danforth discloses a computer program product for storing and distributing a computer program (column 6 line 47 – column 8 line 8).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use Danforth's computer program product with the tracing circuit of APA and Westcott. One of ordinary skill in the art would have been motivated to sell and distribute the computer program.

All other limitations have been addressed in the above rejection of claim 12.


Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to J. Derek Rutten whose telephone number is (703) 605-5233. The examiner can normally be reached on M-F 6:30-3:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tuan Q. Dam can be reached on (703)305-4552. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703)306-5484.

jdr



TUAN DAM
SUPERVISORY PATENT EXAMINER